

REMARKS

Claims 1-25 are presently pending. Claims 1, 4-6, 11, and 12 are amended. Claims 1, 4-7, 10-14, 16, 19-21 and 25 are independent claims. Claims 13-25 are withdrawn from consideration.

Applicant respectfully submits that the amendments to the claims are fully supported by the original disclosure, and that no new matter has been introduced therewith.

Applicant appreciates the courtesies extended by the Examiner to Applicant's representative during the telephonic interview on May 29, 2001. The present response summarizes the substance of the interview. During the interview Claims 6 and 12 were reviewed and discussed in light of the amendment filed March 8, 2001. The Examiner agreed to withdraw the rejection of Claims 6 and 8/6 under 35 U.S.C. § 112, second paragraph.

Claims 6 and 8/6 are rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Applicants submits that the agreement reached in the above-described interview renders this rejection moot. Accordingly, Applicant respectfully requests reconsideration and withdrawal of this rejection of Claims 6 and 8/6 under 35 U.S.C. § 112, second paragraph.

Claims 1-4 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Okada et al. (U.S. Patent No. 5,690,846) in view of Hans et al. (U.S. Patent No. 5,582,745).

Claims 1 and 4 are amended to clarify the claimed invention. Amended Claim 1 specifies a multilayer printed wiring board manufacturing apparatus that includes a processing laser source, a scanning head, a camera, an X-Y table, an input section, a memory section, and an arithmetic operating section. Processing data is input from the input section and this processing data is stored in the memory section. A position of a positioning mark of the multilayer printed wiring board is measured with the camera. The processing data is corrected on the basis of the measured position of the positioning mark to generate X-Y table drive data in the arithmetic section and this drive data is

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then stored in the memory section. The drive data is read from the memory section and then the X-Y table and the scanning head are controlled in a control section and thereby the laser beam is radiated to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole.

Amended Claim 4 specifies a multilayer printed wiring board manufacturing method. The method forms a positioning mark covered interlayer insulating agent layer and an interlayer insulating agent layer on a multilayer printed wiring board, and places the multilayer printed wiring board on an X-Y table of a multilayer printed wiring board manufacturing apparatus that includes a processing laser source, a scanning head, a camera, an X-Y table, an input section, a memory section, and an arithmetic operating section. The method then measures a position of the positioning mark of the multilayer printed wiring board with the camera, corrects the input processing data based on the measured positioning mark position to generate scanning head and X-Y table drive data in the arithmetic operating section and then stores this drive data in the memory section. The method then reads the drive data from the memory section to control the X-Y table and the scanning head in a control section and radiates the laser beam to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole.

In the present invention, the position is corrected on the basis of the measured positioning mark position; and the via hole is formed in the interlayer resin layer. When the positioning mark was made, the position of the positioning mark was shifted. The shift was caused by mechanical reason or physical reason. Without adjusting the shift, the via hole cannot contact with a conductive circuit.

Therefore, in the present invention, the processing data is input, a position of the positioning mark is measured, the position is adjusted and the input processing data is corrected, and the via hole is formed. That is, before the laser processing, the data is corrected.

Okada et al. discloses a laser processing apparatus to make holes and to cut and weld processed objects. The apparatus has a CO<sub>2</sub> laser machine, an X-Y table, and a CCD camera. The CCD camera measures processed holes. That is, the camera measures a position precision of the hole. The measured result and a position of a coordinate of the coordinate point are compared, the difference from the original position is obtained, and the position of the coordinate is adjusted. Thereafter, the laser can be radiated to the accurate position of the coordinate (col. 6, lines 6-9).

In Okada et al., the processing data is input, a temporary laser process occurs, a measurement of the object is made by the camera, the position is adjusted, and the laser processes the object. The above steps are repeated. After the laser processing, the data is corrected.

More particularly, in Okada, a processed hole is measured. However, in the present invention, the positioning mark is measured. In addition, Okada et al. does not suggest a via hole process for a printed circuit board.

Hans et al. discloses a technique for manufacturing a circuit board that includes drilling holes in a dielectric layer via a laser and applying positioning marks (global registration marks).

Hans et al. does not teach that the processing data is corrected based on measuring the positioning marks with a camera. Since, in Hans et al., the positioning marks used are photo-lithographic. In the photo-lithographic process, an expose mask having a circuit pattern is set on a circuit board, and exposed, and developed. When the mask is set on the circuit, a positioning mark of the mask and the positioning mark of the circuit are laid.

Okada et al. and Hans et al. provide no motivation whatsoever to modify the teachings thereof to provide a multilayer printed wiring board manufacturing apparatus that includes a processing laser source, a scanning head, a camera, an X-Y table, an input section, a memory section, and an arithmetic operating section, wherein processing data is input from the input section and this processing data is stored in the memory section, a position of a positioning mark of the multilayer

printed wiring board is measured with the camera, processing data is corrected on the basis of the measured position of the positioning mark to generate X-Y table drive data in the arithmetic section and this drive data is then stored in the memory section, drive data is read from the memory section and then the X-Y table and the scanning head are controlled in a control section and thereby the laser beam is radiated to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole, as Claims 1-3 require.

Okada et al. and Hans et al. also provide no motivation whatsoever to modify the teachings thereof to provide a multilayer printed wiring board manufacturing method that forms a positioning mark covered interlayer insulating agent layer and an interlayer insulating agent layer on a multilayer printed wiring board, places the multilayer printed wiring board on an X-Y table of a multilayer printed wiring board manufacturing apparatus that includes a processing laser source, a scanning head, a camera, an X-Y table, an input section, a memory section, and an arithmetic operating section, measures a position of the positioning mark of the multilayer printed wiring board with the camera, corrects the input processing data based on the measured positioning mark position to generate scanning head and X-Y table drive data in the arithmetic operating section and then stores this drive data in the memory section, and then reads the drive data from the memory section to control the X-Y table and the scanning head in a control section and radiates the laser beam to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole, as Claim 4 requires.

Applicant respectfully requests reconsideration and withdrawal of this rejection of Claims 1-4 under 35 U.S.C. § 103(a) as being unpatentable over Okada et al. in view of Hans et al.

Claims 5, 6, 11 and 12 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Muncheryan (U.S. Patent No. 4,979,180) in view of DeRossett, Jr. (U.S. Patent No. 5,298,717) and Okada et al. Claims 8/5, 8/6, 9/8/5 and 9/8/6 are rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Muncheryan in view of DeRossett, Jr., Okada et al., and Roland et al. (U.S. Patent No. 3,792,287). Applicant respectfully traverses these rejections.

Claims 5, 6, 11, and 12 are amended to clarify the claimed invention. Amended Claims 5 and 11 each sets forth that the diffraction of the laser beam is controlled and forms a via hole. Amended Claims 6 and 12 each set forth that the laser source forms a via hole that exposes a conductive in an interlayer resin. Claims 8/5, 8/6, 9/8/5 and 9/8/6 are rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Muncheryan in view of DeRossett, Jr. and Roland et al. (U.S. Patent No. 3,792,287).

Muncheryan discloses a modular interchangeable laser system. Muncheryan fails to teach or reasonably suggest controlling the diffraction of the processing laser source disclosed therein to form a via hole, as required by Claims 5, 8/5, 9/8/5, and 11. Muncheryan also fails to teach or reasonably suggest using the laser source disclosed therein to form a via hole that exposes a conductive in an interlayer resin, as required by Claims 6, 8/6, 9/8/6, and 12. DeRossett, Jr. discloses a method and apparatus for laser inscription of an image on a surface, wherein laser power is controlled to avoid damaging the structural integrity of the glass (abstract). DeRossett, Jr. fails to supplement the deficiencies of Muncheryan because DeRossett, Jr. fails to teach or reasonably suggest teach or reasonably suggest controlling the diffraction of the processing laser source disclosed therein to form a via hole, as required by Claims 5, 8/5, 9/8/5, and 11. DeRossett, Jr. also fails to teach or reasonably suggest using the laser source disclosed therein to form a via hole that exposes a conductive in an interlayer resin, as required by Claims 6, 8/6, 9/8/6, and 12. Okada et al. fails to supplement the deficiencies of Muncheryan because Okada et al. fails to teach or reasonably suggest teach or

reasonably suggest controlling the diffraction of the processing laser source disclosed therein to form a via hole, as required by Claims 5, 8/5, 9/8/5, and 11. Okada et al. also fails to teach or reasonably suggest using the laser source disclosed therein to form a via hole that exposes a conductive in an interlayer resin, as required by Claims 6, 8/6, 9/8/6, and 12. Roland et al. fails to supplement the deficiencies of Muncheryan because Roland et al. fails to teach or reasonably suggest teach or reasonably suggest controlling the diffraction of the processing laser source disclosed therein to form a via hole, as required by Claims 5, 8/5, 9/8/5, and 11. Roland et al. also fails to teach or reasonably suggest using the laser source disclosed therein to form a via hole that exposes a conductive in an interlayer resin, as required by Claims 6, 8/6, 9/8/6, and 12.

Applicant respectfully requests reconsideration and withdrawal of the rejection of Claims 5, 6, 11 and 12 under 35 U.S.C. § 103(a) as being unpatentable over Muncheryan in view of DeRossett, Jr. and Okada et al., and the rejection of Claims 8/5, 8/6, 9/8/5 and 9/8/6 under 35 U.S.C. § 103(a) as being unpatentable over Muncheryan in view of DeRossett, Jr., Okada et al., and Roland et al..

The indication by the Examiner that Claims 7, 8/7, 9/8/7 and 10 are allowable is noted with appreciation.

In sum, Applicant respectfully submits that none of Okada et al., Muncheryan, DeRossett, Jr., and Roland et al., or any combination thereof disclose or suggest the claimed invention and that all of the pending claims are in condition for allowance, which action is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and the claims by the current amendment. The attached Appendix is captioned "Version with markings to show changes made."

Respectfully submitted,

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Enclosure: Appendix



APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claims 1, 4-6, 10, and 11 were amended as follows:

1. (Twice Amended) A multilayer printed wiring board manufacturing apparatus, to be used for processing a multilayer printed wiring board having an interlayer resin insulator, comprising:

a processing laser source, a scanning head for deflecting [the] a laser beam in [the] X-Y directions, a camera for reading [the] positioning marks covering the interlayer resin insulator of [a] the multilayer printed wiring board, an X-Y table for placing [a] the multilayer printed wiring board, an input section for inputting [the] processing data of the multilayer printed wiring board, a memory section for storing the processing data or [the] an arithmetic operations result and an arithmetic operating section, wherein

the processing data is input from the input section and this processing data is stored in the memory section;

a position of [the] a positioning mark of the multilayer printed wiring board placed on the X-Y table is measured with the camera;

the input processing data is corrected on the basis of the measured position of the positioning mark to generate [the] X-Y table drive data in the arithmetic section and this drive data is then stored in the memory section; and

the drive data is read from the memory section and then the X-Y table and the scanning head are controlled in [the] a control section and thereby the laser beam is radiated to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole.

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4. (Twice Amended) A multilayer printed wiring board manufacturing method comprising the steps of:

forming [the] a positioning mark covered interlayer insulating agent layer and an interlayer insulating agent layer on a multilayer printed wiring board; placing a multilayer printed wiring board having formed said positioning mark on [the] an X-Y table of [the] a multilayer printed wiring board manufacturing apparatus consisting of a processing laser source, a scanning head for deflecting [the] a direction of a laser beam in [the] X-Y directions, a camera for reading the positioning mark of the multilayer printed wiring board, an X-Y table for placing the multilayer printed wiring board, an input section for inputting [the] processing data of the multilayer printed wiring board, a memory section for storing the processing data or [the] an arithmetic operations result and an arithmetic operating section, and inputting [the] process log data to this manufacturing apparatus:

measuring [the] a position of the positioning mark of the multilayer printed wiring board with the camera, correcting the input processing data based on the measured positioning mark position to generate [the] scanning head and [the] X-Y table drive data in the arithmetic operating section and then storing this drive data in the memory section; and reading the drive data from the memory section to control the X-Y table and the scanning head in [the] a control section and radiating the laser beam to the multilayer printed wiring board to eliminate the interlayer resin layer to form a hole for a via hole.

5. (Twice Amended) A multilayer printed wiring board manufacturing apparatus comprising a CO<sub>2</sub> laser source, a scanning head for deflecting [the] a direction of a laser beam in [the] X-Y directions or an X-Y table for displacing [the] a position of [the] a multilayer printed wiring board, wherein the laser beam oscillated from said CO<sub>2</sub> laser source is converted to [the] a beam of shortened wavelength by harmonic wave generating means, a diffraction of the laser beam is controlled, and the laser beam forms a via hole.

6. (Twice Amended) A multilayer printed wiring board manufacturing apparatus comprising a processing laser source, harmonic wave generating means for converting [the] a laser beam oscillated from said processing laser source to [the] a shortened wavelength beam of a second harmonic wave and a scanning head for deflecting [the] a direction of the laser beam in [the] X-Y directions or an X-Y table for displacing a position of [the] a multilayer printed wiring board, wherein [the] a wavelength of said processing laser source is between 720nm and [the] a minimum wavelength of the laser source, or between 6000nm and [the] a maximum wavelength of the laser source, and said processing laser source forms a via hole exposing a conductive in an interlayer resin.

11. (Twice Amended) A laser processing apparatus comprising a CO<sub>2</sub> laser source, a scanning head for deflecting [the] a direction of a laser beam to [the] X-Y directions or an X-Y table for displacing [the] a position of a work piece to be processed, wherein the laser beam oscillated from said CO<sub>2</sub> laser source is converted to [the] a shortened wavelength beam by harmonic wave generating means, a diffraction of the laser beam is controlled, and the laser beam forms a via hole.

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12. (Twice Amended) A laser processing apparatus comprising a processing laser source, harmonic wave generating means for converting [the] a laser beam oscillated from said processing laser source to [the] a shortened wavelength beam of [the] a second harmonic wave, and a scanning head for deflecting [the] a direction of the laser beam to [the] X-Y directions or an X-Y table for displacing [the] a position of a work piece to be processed, wherein [the] a wavelength of said processing laser source is between 720nm and [the] a minimum wavelength of the laser source, or between 6000nm and [the] a maximum wavelength of the laser source, and said processing laser source forms a via hole exposing a conductive in an interlayer resin layer.

End of Appendix

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